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I work on the Design for the Environment Program at the EPA and we are a voluntary partnership program. The partnership that I'm talking about today is a partnership that we have on flame-retardants and printed circuit boards. And a lot of work that we do follows the same model that Wayne talked about, collaborative, multi stakeholder partnership, trying to figure out what the solution is.

Our work complements a lot of the work that EPEAT is doing in this one particular area, in the area of flame-retardants and that EPEAT provides a way to identify which products use better materials. However, how do you which materials are better? That's one of the problems that manufacturers are facing when they look at flame-retardants and that's what our partners are trying to figure out and specifically focusing on one flame retardant chemical. Or one particular flame retardant chemical use, I should say.

Just a quick overview of my presentation. I'll just give you an overview of the Design for the Environment Program so you'll have an appreciation for the type of work that we do in our program. And then talk about the partnership that we're working on.

Then I'll talk about a couple of the key parts of our partnership which is looking at hazard assessments of chemicals. I'll talk about the methodology that we used and the draft results and how we're presenting the results. And then the part that ties into the electronics waste picture which is the end of life considerations. What type of testing we're doing, what we're trying to get out of that testing. And how that all ties into the disposal of electronics. And then a status report of where we are on the project and when the information will be available.

The Design for the Environment Program, as I mentioned, is a voluntary partnership program. We focus on chemicals of concern and work with industry to figure out how to move towards safer chemicals. We focus on an area that we called informed substitution. Informed substitution is a transition from a chemical of a concern to a safer chemical or a non-chemical alternative based on scientific information. It's a difficult process and it's hard sometimes to know if you're moving in the right direction.

But as we had mentioned, you have to gather new information all the time and make sure that you're moving in the right direction and there's continuous improvement involved in it as well. Sometimes you make the best decision you can on the information you have today and then tomorrow you have new information and you update your direction and try to make further improvements.

Our office, OPPT, the Office of Pollution Prevention and Toxics regulates industrial chemicals in the U.S. Through that program we have developed tools and have experts in understanding the hazard concerns of chemicals being able to look at chemicals without having very much data and make estimates or determinations based on the structure of the chemicals as to whether or not we think those will be of concern.

Being able to share that kind of information with industry and with others is very important as they look at different chemicals and try to make decisions about where to move. Our program uses industry as a driver for our projects. The industry comes to us and they want to make a change or they want information that they're going to use, so they're our main driver in our partnerships. The multi stakeholder participation is a key element as well. You can't just work with one group, you only have that one set of information being able to bring all these groups together is very important to have as much information as possible on the table.

Then, of course, we consider the realities of business, which is that when we look at alternatives, we're looking at things that work. How they perform, things that are cost effective and we look for areas where we can have a potential for lasting change, where business is ready to make change or is being pressured to make change either because of a regulation or because of market pressures. And we look also for potential benefits to the environment, where are really going to have the biggest impact on improving the environment?

Here is a list (on slide) of some of our most recent partnership programs that we've worked on. We have three main types of partnerships that we work on. One of them we call, DFE. It stands for the Design for the Environment. And the first type of project we call "alternatives assessments". These types of projects are focused on looking at these chemicals of concern for a specific functional use and trying to figure out what safer substitutes exist and evaluating all of those in a non biased scientific way.

The furniture flame retardancy partnership is a partnership I worked on a couple of years ago and it's actually what this partnership came out of that original partnership, the electronics industry looked at the work that we had done in that partnership and liked the approach for looking at flame retardants and printed circuit boards. That partnership was focused on looking at alternatives to pentabromodiphenyl ether which is one of the PBDEs you may have heard of. It's a polybrominated diphenyl ether type of chemical. It's a brominated flame retardant that's used in furniture foam. It was phased out in the U.S. by the manufacturer and so this partnership is looking at ways where should the industry go next, what type of flame-retardants for film.

I think this is a good a time as any other to clarify the difference between flame-retardants. You hear the term brominated flame retardant used a lot. It's important to realize that there are a lot of different kinds of brominated flame retardants. Usually that's referring to poly brominated diphenyle ethers, pentaBDE, octoBDE, decaBDE, deca's the one's that used in electronics, but there's lots of other brominated flame retardants as well. In fact the one that I am going to talking about is tetrabromobiphenol A (TBBPA), which is the highest volume brominated flame retardant in commerce today,

but there's others as well. And some of the substitutes for these chemicals of concern may be brominated as well.

So I think that's important to keep in mind. Bromine is one of the elements that's used in these flame retardants and it's used because it's effective at quenching fires and there's other approaches to quenching fires as well and we're looking at some of those as well, but I just wanted to make sure that was clear up front.

In addition to these partnerships on flame retardants, we also have done an alternatives assessment looking at the lifecycle of solder and electronics, the lead free solders in electronics. And most recently are working with the wire and cable industry doing a lifecycle assessment of wire and cable's first specific billing applications.

Another type of program that we have at DfE, one of our main programs is the DfE Formulator program. This is for folks who formulated chemically intensive products. There are two approaches we have right now in the formulator program. One is recognizing safer formulations. When you have, especially in the area of cleaning products, we've done a lot of work to look at products, looking at the functional types of ingredients in those products. So, for example, in a cleaning product you have surfactants and chelating agents and solvents and fragrances, all these different types of ingredients and try to make sure that manufacturers are using the safest ingredient in each of those classifications or in each of those categories.

And also making sure that none of those chemicals they use have negative synergistic reactions when used together. We have a recognition program where companies can submit their products and be recognized if they're really on the high end of making the safest products available.

Then another program that we're just starting now that we intend to launch this spring is the Safer Detergents Stewardship Initiative. This initiative is aimed at encouraging the use of safer surfactants. So instead of doing a product by product look at company's products, I guess recognizing things on a product by product basis, it's looking at companies' entire product line and encouraging them to move to safer surfactants to move away from nonylphenol ethoxylates, which is one of the surfactants that could be used as a detergent, as a surfactant in products. And encouraging them to move toward safer ones.

Then finally our auto refinishing best practices program is aimed at more broadly looking at areas where you don't necessarily have safer substitutes for auto refinishing, but there are best practices to reduce worker exposure.

So let me get into this project on flame retardants. The purpose of this project that we defined in our stakeholder group is to evaluate flame retardants for FR-4 laminate materials and printed circuit boards.

What is a laminate material? You get into a lot of technical details here when you really try to understand what flame retardants are used for their application. A laminate material is what you use, if you're familiar with a printed circuit board, some of them are

green in color and they have all those little components on the top. And there are stacks of copper and laminate material that are pressed together. There is etching in between them and they're much more complex than this, but this is the simplified version. And then they have all the components on top; resisters, transistors, et cetera, that makes them work.

So the laminate materials are based on epoxy resin, which is a plastic material, and the flame retardant is mixed in with that plastic material. It is hardened and then it's sandwiched by copper layers.

FR-4 is a designation for Flame Retarded boards that use these epoxy resins and they meet a fire safety standard called the UL94V0 standard. This is the industry's standard for flame retardancy printed circuit boards. I have this diagram of a lifecycle of a flame retardant through the printed circuit board here which I'll discuss a little bit in more detail later on. But the purpose of this lifecycle diagram is to demonstrate that we're interested not only in the specific flame retardants themselves as chemicals but also as they move through this lifecycle and where there are opportunities for exposures in transformations of those flame retardant chemicals.

So why are we looking at printed circuit boards and why are we specifically looking at these FR-4 boards? The reason is that one of the highest brominated flame retardant I mentioned earlier is tetrabromobisphenol A, also known as TBBPA. It's used at 330 million pounds per year, which is a very high volume for a chemical. And what is its use? Its use is primarily as a flame retardant for these FR-4 boards.

The FR-4 boards make up the majority of printed circuit boards, however there are other materials that are being used. The industry came to us because a lot of manufacturers, as they try to move beyond compliance and get ahead of the curve, before regulation, before EPEAT mandated that they move away from certain chemicals, they're trying to understand what the potential impacts are of some of these chemicals and where there are opportunities for substitution.

Many of the OEMs have made commitments to eliminate brominated flame retardants from other products by 2008, by 2009, very short time frames, but most of those are pending the availability of safer substitutes. And that's what we're trying to figure out in this project here.

It's important to understand what the concerns are about TBBPA. The concerns are over, one, the environmental impact of the material. TBBPA is an aquatic toxin, so there's concern about it getting out into the environment as a chemical. And there is also concern over the byproducts, the combustion byproducts that could be produced when these materials that have TBBPA in them are burnt. This is where you get into the electronics waste end of it.

Just a bit more about the partnership. We have a very wide range of stakeholders who are guiding this work. We have a steering committee and a technical committee. The steering committee is comprised of about six individuals from different companies that

represent flame retardant manufacturers, electronic suppliers, the electronics manufacturers' environmental groups. We also have universities involved and more recently, as we've been trying to figure out the electronics waste, the testing part of this partnership, we've involved recyclers or smelters, really, such as Belead [sp?] and try to make sure that the work we're doing is relevant for their industries.

The goal statement (on slide) was developed with all of the stakeholders, so it took a while, but hopefully it characterizes what we're trying to achieve. The goal is to identify and characterize commercially available flame retardants and their environmental health safety and environmental fate aspects and FR-4 printed circuit boards.

To do this we have a two part approach. One is to understand the hazards of the flame retardant chemicals themselves. The other is to highlight and to research how those chemicals are released throughout the lifecycle. What chemicals are used to produce those flame retardants as well as how they are transformed through the lifecycle and then what happens to them under thermal treatment and at the end of life? Pretty difficult.

So what did we look at? Are there available substitutes? Yes, there are substitutes that are being used for TBBPA and the laminate materials. Some of them are in the market in products right now. However, there are still questions about their long term performance and their performance in the higher end type of electronics applications, such as servers. The laminate materials we decided to look at. Here are some of the companies (slide) that make those laminate materials. What we did is go to the laminate manufacturers to ask them what flame retardant chemicals they are using.

Many of the flame retardant chemicals are similar across the board, but because of confidentiality reasons, laminate manufacturers do not want to disclose what flame retardants they are using. If they are halogen free it gives them a market advantage to have one of the products and maybe they find the perfect combination of something that works and they don't want a competitor to know what they are using.

Of course, this is tricky from our perspective because we want to know from an environmental perspective what types of chemicals they are using. So they agreed to disclose to EPA confidentially what materials they were using as long as those materials were not directly tied back to those laminate materials.

Of course when this comes down the line and purchasers are trying to make a decision, some of this information may have to be disclosed, at least within companies and supplier relationships.

We definitely considered performance when choosing these materials to evaluate. They were actually selected by the International Electronics Manufacturing Initiative, also known as IEMI, which right now is doing a parallel effort to look at the performance of these laminate materials testing the electrical and mechanical properties.

Another group called the High Density Packaging User group is compiling existing information on the performance of these laminate materials in a database. So there's

really a lot of work going on right now trying to find safer substitutes that work that are cost effective, but it's not easy. None of the work is easy.

For the hazard assessments, we conducted the hazard assessment of those flame retardant chemicals and let me step back one second. Over here, TBBPA's, the conventional flame retardant, a chemical called DOPO and the full name the chemical is very long; Fryolflex PMP, it's a trade name for a chemical that's named by CL[sp?] Industrial Products. Aluminum hydroxide, Exolit OP930 is another proprietary product that is made by a company called Clariant[sp?], it's phosphorous based. And Melpur 200 which is a melamine polyphosphate chemical. And finally silicon dioxide.

So these are the chemicals that we looked at. In order to look at these, the methodology we used is the one that we developed to look at flame retardants in the furniture flame retardancy partnership I worked on we developed this methodology to look at alternatives to pentaBDE. And how it works is we review all the information that's available in the literature on these chemicals. We determine whether the end points, meaning that there are several human health points in cancer, immuno-toxicity, neuro-toxicity, et cetera, I'll show you in a moment, that determine whether those end points can be adequately characterized based on the tests that we've reviewed. And if those tests are adequate, there are guidelines that OECD has developed on how these tests should be performed.

We also take measured confidential information that we have at EPA and that chemical companies have that they share with us. And in addition where we don't have data on the chemicals we use estimations from our new chemicals program based on the structure of the chemicals. And that's a pretty important piece of this since for a lot of the end points there isn't very much data on these chemicals. Finally we use the professional judgment of our EPA staff, our toxicologists to make determinations on some of the end points.

Then we summarize these assessments. We have very detailed assessments that are several pages long that summarize all the different studies and what the values are. But we have this summary table that I'll show you in a minute that for each of the environmental and human health end points gives the chemicals a high moderate or a low concern for a hazard. This is just hazard. We'll get to exposure and risk in a moment.

So this example is based on the furniture flame retardants report. We have put together a draft of the chemical review for TBBPA, DOPO and the other chemicals used for circuit boards, but that won't be ready for public review for a couple of more months. Right now it's going in internal review by our technical committee.

And the way that table works is you have the trade name of the chemical that's being used, sometimes there can be more than one type of ingredient in this trade name, in this formulation. We rank them by their percent in formulation. The manufacturers can give us ranges, if they would like to, for percent and formulation, since this is often confidential. But when they don't want to give us information on percent in the formulation, we simply rank it from the highest percent in formulation to the lowest percent in the formulation.

These are the human health effects I was referring to. Cancer hazard, skin sensitization, reproductive and development impacts, neurological impacts, systemic and geno-toxicity. So we look at all these human health impacts to determine whether or not we think there's a low, moderate or high concern for that chemical.

The low means we have no basis for a concern. We also looked at the eco-toxicity. This is based on aquatic toxicity on acute and the chronic endpoints. For the environmental endpoints we also looked at the ability to persist and bioaccumulation in the environment, which is important when you're trying to figure out the exposure potential.

What are all of these different black and white and colored and LMH and asterisks (on slide)? What does it all mean? When you see the italics, this means that we don't have any data on this chemical. There haven't been any tests done, but EPA has looked at the structure of the chemical and this is what we predict would happen.

And the companies may do more testing in the future. And the example of this chemical here, where you see the asterisk here and here, that means that the chemical is currently doing a study, to study the endpoint more for that chemical.

Where you see the ... colored L, M and H, that's based on data that we've reviewed and this is how we characterize the chemical based on that data. And then finally over here you see a little triangle. For persistence, sometimes the main chemical is not persistent, but the byproduct can be persistent. Or the degradation product can be persistent. So the little triangle there indicates that while we do not expect the chemical itself to be persistent, we expect the degradation product to be persistent.

So that's the hazard part of the picture. But how does this all tie into risk? Well, the risk of a chemical is its hazard potential times its exposure potential. Exposure is very difficult to determine, especially when you're substituting new chemicals and you don't know a lot about how they are going to be released from chemicals.

Even with TBBPA we do not have a lot of information on how it may be getting out of chemicals. You can get an indication of whether people and the environment is being exposed to chemicals through bio-monitoring data. But it does not necessarily tell you where that chemical is coming from. It could be coming from the manufacturing process. It could be coming from the board itself, from the end of life.

And the case of TBBPA, TBBPA can be used in addition to printed circuit boards where as it's used reactively. It can also be used as a an additive and as a substitute for DEKA BDE in the enclosure of electronics. And so perhaps it could get out of there if you measure it in the environment.

Looking at the ability for the chemical to persistent and bioaccumulation. Most chemicals in commerce, if they're out there, if they're being used they can get into the environment. Many companies use best practices to make sure they do not get out of the plant during manufacture, but not all companies do.

Another thing to look at for exposure are the physical and chemical properties of these chemicals. If the chemicals are out there in the environment, are they going to solubilize in water and be transported through waterways? Are they going to volatilize through products? This is how you estimate what the exposure potential is and rather than making assumptions about how much is used, how much is getting out to the environment and making a risk assessment determination, we decided in this partnership to instead make information available on the hazards and on the exposure potential of these chemicals.

As I mentioned before, the use of best practices is very important in determining the exposure of these chemicals to the environment and to humans. And the manufacturing process. And how they're treated throughout. And then there's this issue of a reactive versus an additive chemical, which in the case of printed circuit boards, the laminate materials is important.

TBBPA reacts with bisphenol A, which is the basis for the epoxy resin along with other chemicals and hardeners to form this hard substrate. And when it is chemically bound into that plastic, the only amount of TBBPA that exists after that point in the lifecycle is any that did not react into that plastic mixture.

When that plastic or hard substrate breaks down, it can break down into different kinds of chemicals. You probably will not get discrete TBBPA molecules, but perhaps you will get larger brominated (inaudible). And if you treat it thermally you could get other kinds of chemicals coming off as it's transformed.

Additive chemicals, DOPO is one of the leading alternative to TBBPA. DOPO is an additive chemical, so that's added in and although it's locked in by the plastic matrix, it's not chemically bound to the plastic. So it still exists as a flame retardant chemical in that product. So understanding how that chemical could be released, if it could off gas, if you break apart these plastics, can it be released into the environment? These are all important things to consider when you're looking at exposure.

This is back to that lifecycle diagram (on slide). But to try to appreciate all of the different points where you could have exposure to flame retardant chemicals, starting up here you have TBBPA, or you have DOPO, or you have other flame retardant chemicals, mixed in with Phosmonal[sp?] A which is the basis for epoxy resin. Epilcor[sp?] hydron is also used as a chemical to enable that reaction into a plastic and other chemicals and hardeners are used as well.

Those all are transported to the resin producer. Before I keep going through the lifecycle, there's also chemicals upstream of TBBPA, DOPO and others, like phosphorous, aluminum, silicon dioxide, bromine, that have to be mined and brought from somewhere to make these chemicals. That further expands the lifecycle picture. But limiting it to the flame retardants as they travel through the lifecycle, they go to a resin producer who makes a resin, that's the plastic material. That's the reacted at the laminate producer's site with hardeners and others into these hard sheets of laminate material that has the cooper on either side of it.

That's then shipped to a printed circuit board manufacturer. This manufacturing step actually could be broken into many different facilities. You have the manufacturers who make the boards and then the assemblers. And then maybe even somebody else before it goes to the OEM, to Sony, Dell, HP, IBM type of manufacturer. Then it's sent to the electronics store, used and then disposed of. And then this is the whole electronics waste question that we have here.

Is it going to an incinerator? Is it going to a landfill? Is it going to a recycling facility that has controls? Like the ones we talked about where it's shredded and smelted and turned back into useful materials. Or is it going to a recycling facility without controls? That could ultimately turn into materials that are useful. But then there's other types of materials that could be released or produced there.

With an additive flame retardant chemical, that additive one is available throughout this whole lifecycle to be transformed to be released to leach out. With the case of TBBPA, it is only available as a chemical through the laminate producer step. At that point there could be some small amount of TBBPA that's un-reacted that follows throughout the rest of the lifecycle.

However, when you have a reactive flame retardant, you're producing a different substrate. So what's happening with that substrate? If it has bromine in it, there's a concern with halogenated chemicals that you can produce dioxins and furans at the end of the life. But in order to know if that's happening, how much is happening, you really have to test to understand that. If it's happening in an incinerator, that's probably at a very high temperature. And you're destroying most of those chemicals, or the plastics completely. But what about if it's an up-set mode? What if it's not at the highest temperature it's supposed to operate at?

In a landfill ... we don't have good models to know what's happening in a landfill, but we recognize this is one area that there could be exposure to chemicals. And there recycling facility without controls. You have open burning, that can happen, that's been talked about for the last two days. And under those conditions, what's coming off of those? The manufacturers want to know what's happening under all the conditions that they're treated.

And then finally at the recycling facility with the controls, if either the TBBPA or the dopo or the other types of materials are put through these smelters, does that impact the way the smelters operate?

So here is, we talked about these electronic wastes concerns with our large multi stakeholder partnership and technical committee. And the greatest concern was over the potential for the formation of hazardous thermal degradation products through open burning but also through some of the other burning scenarios.

It's important to point out that neither EPA nor any of these partners condone open burning and these non controlled disposal practices, but I think everybody recognizes that they have been documented and they're out there. And the manufacturers want to know

what's happening so that they can design materials better. They know when they substitute one material for another, what's going to happen at the end of life.

The scenarios that we discussed and considered for testing included the open burning, smelting, incineration. We also talked about off gassing and landfill. For off gassing we identified some testing needs but we haven't, that work has not been funded yet. For the landfill work we have not identified appropriate methods for testing to see if the materials are leaching out from landfills.

How did we approach this? Well, we talked as a workgroup about what information was needed? The goal that we defined, finally, after discussing everybody's concerns and what everybody was trying to get out of this, is that what we really wanted to do is compare the combustion byproducts from these FR4 laminate materials and printed circuit board materials, looking at different flame retardants that were used. And looking at these different thermal end of life processes, we wanted to consider open burning, incineration and smelting.

There's a lot of challenges in trying to test for this and compare these byproducts. It's not simple. Fires are very complex. It's very difficult to reproduce two different fires. You have different temperatures, different conditions, within a fire. So one of the challenges we discussed was how do you reproduce these scenarios?

What we decided to do is to look at this system in a controlled lab environment where you look at discrete temperatures and pressures and conditions, it was controlled to a lot of fairly compared between materials. But we also recognize that those results will not be entirely representative of what will happen in a real world condition.

So the idea is that this testing that we are going to do is the first step in providing industry with a comparative analysis of the types that byproducts that could be produced under these certain thermal conditions.

It's not going to allow us, unfortunately, to say that this is what is being produced when you incinerate or open burn. But it gives you an idea. The other challenge we faced is measuring unknown byproducts. You don't know what you don't know. People expect that dioxins and furans will be produced or could be produces. That polyaromatic hydrocarbons could be produced as well as other chemicals.

But when you have different flame retardants being used in these laminate materials, there are other types of phosphorous products and other products that you don't know could be formed. Our approach to this is you do the best you can. We're using gas-photography and mass spectroscopy to try to measure what types of products could be formed and look at peaks to see what's available. And then measure for specific other anolites to see what we find.

And then another challenge, of course, is small sample sizes. When you're working in a lab environment, if you only have a very small sample size, some of the amounts of these products coming off are very small and very hard to detect. But if you have a very large

fire, then you'll have much more of these materials in that fire and the amount of byproducts coming off is much larger.

After defining all of these needs with the technical committee group, we developed a proposal and consultation with our office, EPA's office of research and development which has done some work on combustion testing. But the University of Dayton Research Institute are the folks that really pulled together a proposal. They've had a lot of experience doing combustion testing of materials using Quartz Tube Reactors which take milligram samples of materials. It's a device that's used to screen for organic compounds using GC/SM, the Gas Chromatography Mass Spectrometry [sp?] ... and looking at a number of different temperatures and different atmosphere conditions to see what kind of byproducts could be formed.

And the University of Dayton Research Institute also has experience with a Cone Calorimeter, which is a larger scale way to simulate a fire. The methods that we're planning to use for analysis are XRF Analysis, X-Ray Fluorescents, to determine what's in the materials that we're testing. GC/MS, to determine what's coming out. And we're going to analyze for carbon monoxide, carbon dioxide, oxygen, halogenated dioxins and furan, the polyaromatic hydrocarbons, other organics, heavy metals, bromine and acid gases.

So those are the types of chemicals we know we're looking for. But there could be others that we find that we don't know yet. We're approaching this in two phases. The first phase is to try to confirm our experimental methods to make sure that we have the right approach. We're looking at three different materials to start with. One laminate material based on TBBPA, one based on phosphorous and a control that has no flame retardant at all.

We're also doing a few replicates to see the variability we get in our test methods and then after we finish phase I we'll bring the results back to the technical committee to look and to see what results we have to make sure our approach for a phase II makes sense. Right now our phase II approach includes additional laminate materials and also trying to understand the contribution of flame retardants and laminate materials to the byproducts versus flame retardants that could be used in the components such as the transistors and et cetera, the materials on top of the board.

And the conditions and replicates we do there will be based on phase I but we have identified in the proposal a number of the different conditions to run. This testing by UDRI is actually being sponsored by industry. The sponsors so far we have listed here, Boliden, which is a smelter, Supresta is a flame retardant manufacturer. ITEQ makes laminate materials. HP, Sony, Intel, Dell, Fujitsu, Siemens, IBM, Matsushita, a number of electronic manufacturers, other flame retardant manufacturers; Clariant, Ciba, Nabaltec, BSEF, which represents the bromine industry and the manufacturers of TBBPA, Isola - another laminate manufacturer. A broad range of industry sponsors for this work.

And they are paying for the work. And then we, EPA is contributing the analysis of all of the byproducts that come off of the experiments from UDRI are being sent to EPA for analysis. Richard Stnebich at the University of the Dayton Research Institute is the lead researcher at UDRI and then Brian Gullet at the EPA Office of Research and Development is the lead researcher on doing the analytical work, especially the work to analyze for dioxins and furans.

In addition to these sponsors, the in-kind contributors, Isola and Nan Ya, Matsushita, and ITEQ are the laminate manufacturers who will be providing samples for the testing. And right now Isola is actually in the process of making the first set of samples this week.

So here's a quick status update on the projects. We have all these folks guiding the partnership and so far we finished evaluating the ecological and human health hazards, the fate of the flame retardant chemicals. This is being reviewed in a full report by the technical committee right now. That will be released, we're preparing that draft report, it will be released for public comment probably around the February time frame..

We're preparing the samples and then after we finish the combustion testing then we will write up those results in a separate report and publish those. But that will probably be at the end of next year. The testing is expected to take about eight or nine month's total.

So stepping back a little bit to the big picture. It's important to think about how, you know, the whole electronics waste picture and certainly flame retardants is just one small part of this. But you have to look at it one chemical at a time. The flame retardants are important for making sure the electronics don't catch on fire. So you definitely need materials that aren't going to catch on fire.

Design is one way to help address the electronics waste concerns. If you can design out the problem in the first place then you don't have to deal with it at the end of life. Another thing to consider is that electronics circuit materials are continually evolving. Right now the FR-4 boards that are made of the epoxy resin make up about 60, 70 percent of the printed circuit boards being used in electronics. However, there is also 12 percent of the printed circuit board market that's based on paper, paper composites, five percent on other composite materials and then 12 percent of the market right now is in special applications for use in wireless and high speed digital applications.

The types of materials you see used in there are materials such as polyimide[sp?] and polytetrafluorethylene[sp?], other types of polymers that are used for those applications. So as the electronics keep evolving, it's important not to close yourself into this one box of trying to solve this one solution that could change over time.

There is also a need to better understand the synergies among chemicals and materials, especially in fires. Right now we're looking at the flame retardants and trying to see how those interact between the lanamine materials and the printed circuit board components. But what happens when you introduce those to a large mix of other chemicals in a fire? What happens when you change other materials to phosphorous based or aluminum hydroxide based materials? What types of impacts would that have?

Right now we're working within EPA to share work with folks who are working with, or talking with the folk who work on EPEAT to make sure they are aware of all the information that we have and with the folks in our office of solid waste to make sure that they have the information we've produced.

We also have a lot of international stakeholders involved in our project. Many of the companies we work with are based in Asia or in Europe and we're hoping that working with them will help disseminate this information. Regionally we'd like to work with Mexico and Canada and share information with this on the management of chemicals workgroup. And also build on the Clean Electronics Pollution Prevention Partnership to date.

So I think there are a lot of opportunities to share information. And this conference, this workshop, is kind of a beginning to start sharing that information. As we finish the work that we're doing, we hope to have even more information that we can share for you and models that might be useful for other types of issues that are being address.

So, at this time, thank you all very much. I hope this was helpful and I'd be happy to answer any questions.

I would appreciate it. Thanks a lot.